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PETROLOGICAL AND THERMO-MAGNETIC OBSERVATIONS IN CAINOZOIC BASALTS FROM DROUIN-SOUTH, VICTORIA, AUSTRALIA

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Abstract

Petrological and thermomagnetic studies of samples of Older Cainozoic Volcanics taken from a quarry at Drouin-South suggest the presence of two groups of basic igneous rock. One, possibly a basalt flow, may have suffered post-formational reheating through the intrusion of a large olivine-nephelinite plug.

Introduction

In order to investigate more fully the mixed polarity of magnetization reported by Green and Irving (1958) at certain localities in the Newer and Older Cainozoic Volcanics of Victoria, the writer sampled in some considerable detail a quarry at Drouin-South. Samples were collected around the base of each of the two quarry faces present, and also from the base to top of each of the two faces.

The results of the investigation of the stability of magnetization of the rocks obtained from this quarry have been reported elsewhere by Mumme (1962), but during this investigation it was necessary to make thin sections and polished sections of many of the samples collected, and this paper reports some results of observations made in the examination of these thin and polished sections.

The Geology of the Quarry at Drouin-South

The quarry at Drouin-South has already been described by Mahony (1931). He describes the quarry to consist of an olivine-nephelinite rock, and to be worked on the W. slope of a small hill which rises to about 700 ft above sea level. Several bores were put down to test the area of solid rock and, according to report, it is a volcanic plug. The surrounding soil is typically volcanic, but it contains fragments of indurated slate and sandstone which are probably ejected blocks.

The face of the quarry, as it was when Mahony reported on it, exposed about 40 ft of solid rock with no signs of successive flows. 'In some parts a rough columnar structure is developed. The rock is dense and free from vesicles but contains occasional patches of solid white zeolites which were probably the final minerals to consolidate from the magma.'

Under the microscope, Mahony describes the rock as holocrystalline and panidiomorphic. It consists of nepheline, augite, olivine, iron ore, and apatite. Felspar is absent.

Observations from the Present Investigation

The quarry now has two benches and so two faces are exposed for sampling. As already stated, during the investigation of the stability of the magnetization of these rocks, the writer cut thin sections and made polished sections of many of the samples collected from the quarry in order to examine the grain size and composition of the iron minerals present.

Examination of these sections allowed the division of the rocks into two groups.

(1) The Lower Quarry Group

These were samples collected around the base and up the face of the lower quarry. All of these thin sections were very similar to each other and were distinctive in that they contained nepheline. The main minerals present were: augite; nepheline; olivine, rimmed with iddingsite; iron ore.

As already mentioned, these rocks are part of a plug of olivine-nephelinite rock.

(2) The Upper Quarry Group

These were slides of samples collected at or above the base of the upper bench, and these thin sections were also very similar to each other. They were different in appearance from the lower quarry group, for they were much finer grained. The main minerals present were: augite; olivine, mostly altered to iddingsite; felspar, probably plagioclase; iron ore.

The felspar of the upper quarry group was completely different in appearance from the nepheline contained in the lower quarry group, and it was biaxial (positive) in any case. Albite twinning could also be seen in places throughout the thin sections.

The examination of these thin sections suggested that it was very likely that the two sets of slides represented two different groups of rocks, not only because of the absence of the rather distinctive mineral nepheline, but also because of the fine grained nature of the upper quarry group.

It was not obvious, however, whether the upper quarry group might be a basalt flow which was intruded by the lower quarry group, the olivine-nephelinite plug, or whether it came at a later date after the formation of the plug.

Thermal Demagnetization Experiments

In the course of the investigation of the stability of the magnetization of these rocks, thermal demagnetization experiments, in zero magnetic field, were carried out on them. Fig. 1 shows typical thermal demagnetization curves from specimens taken from the upper quarry group, while Fig. 2 shows similar curves for specimens taken from the lower quarry group.

It is seen from these results that while the lower quarry group contain magnetic minerals which are single phased, the results of the thermal demagnetization experiments on the upper quarry group suggest they contain multiphase magnetic systems.

An examination of polished sections of specimens taken from the upper quarry group showed that, rather than exsolution phenomena being the cause of the thermal demagnetization curves which indicated multiphase magnetic systems, this was caused through the rocks containing whole grains of differing composition. In the case of specimen 2/45, the thermal demagnetization curve of which is given in Fig. 1, grains of a mineral with the appearance of magnetite were observed, together with other grains, which had the brownish appearance in reflected light more characteristic of a titanomagnetite. These are the low and high Curie point components, the presence of which is indicated by the thermal demagnetization curve.

These results are similar to those of Akimoto and Katsura (1958) who found that the titanomagnetites in an olivine-basalt, a dacite and rhyolite consist of several kinds of grains of differing chemical composition. They observed that the chemical composition of these grains selectively separated from the rock, change continuously along the reduction-oxidation lines of the $FeO - Fe_2O_3 - TiO_2$ ternary system.

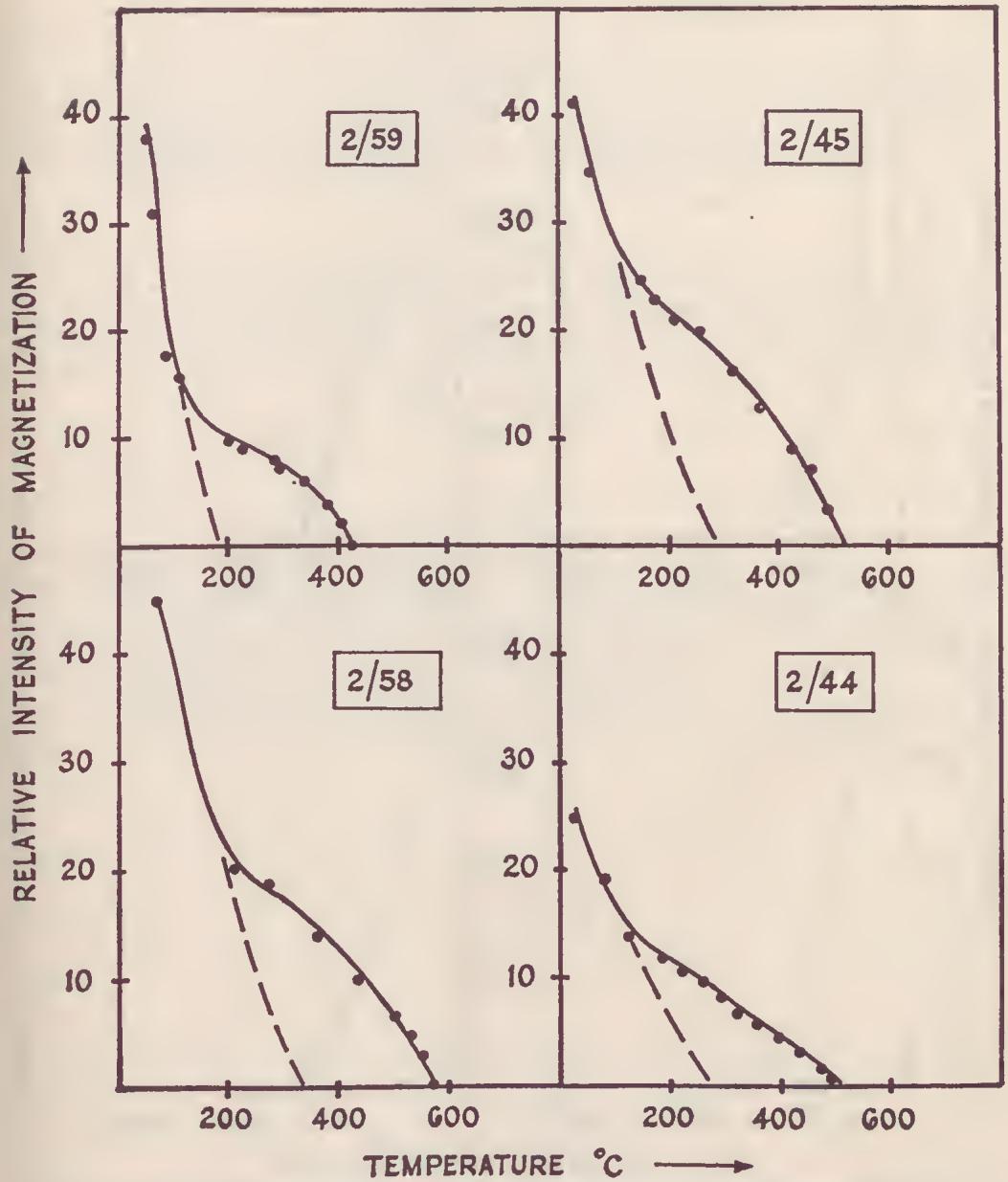

FIG. 1—Typical thermal demagnetization curves for specimens taken from the upper quarry.

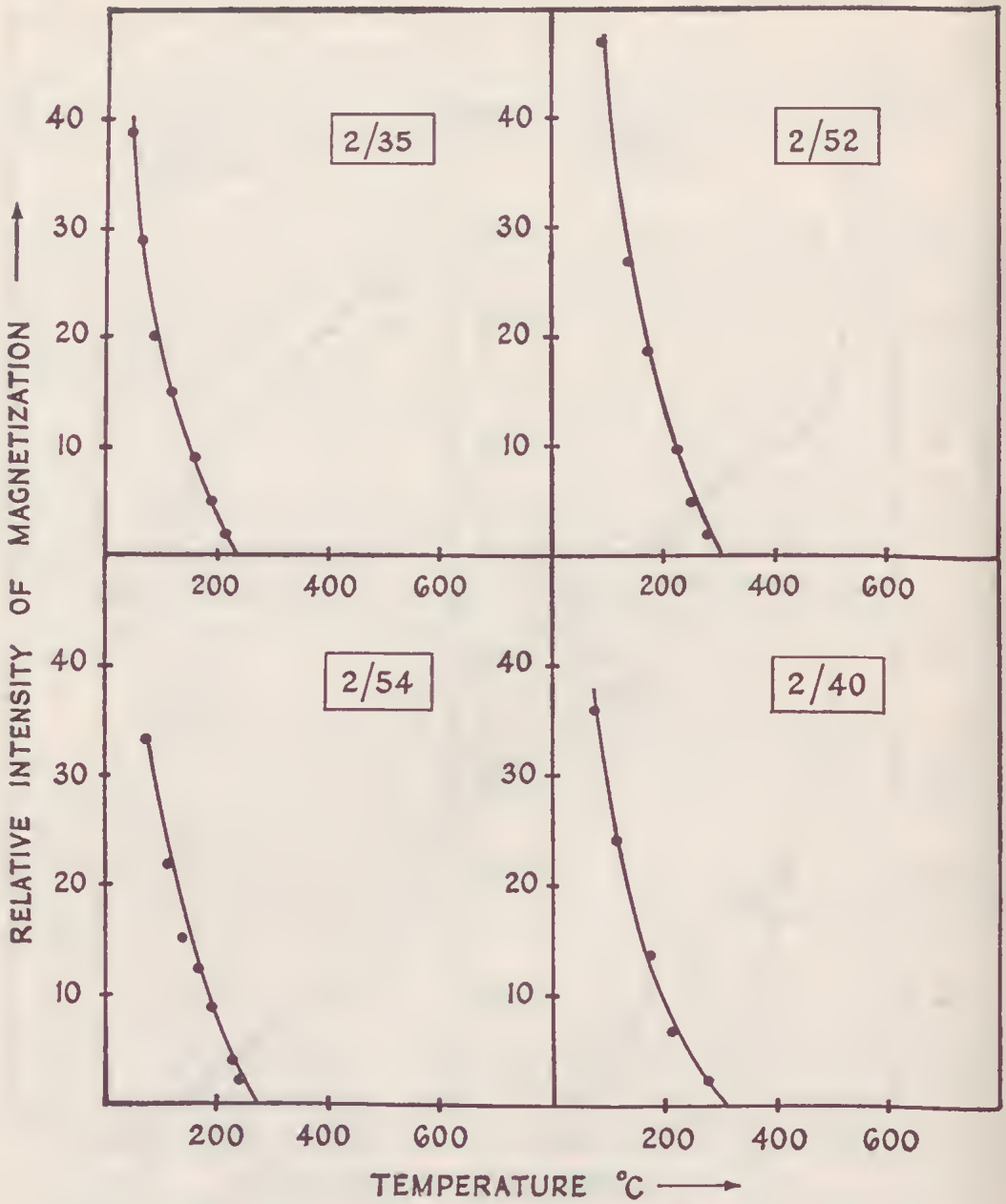

FIG. 2—Typical thermal demagnetization curves for specimens taken from the lower quarry.

The writer has not made observations on the chemical composition of the different grains in these basalts from Drouin-South, but believes that the results of these thermal demagnetization experiments, viewed in the light of previous observations of Akimoto and Katsura and Yoshida (1957) on the oxidation of synthesized titanomagnetites, could perhaps suggest that the upper quarry group, probably a basalt flow, has suffered reheating and oxidation of its iron minerals by the intrusion of the olivine-nephelinite plug at some later date after its formation.

Conclusions

The results of a petrological examination of specimens from the quarry at Drouin-South, together with thermal demagnetization experiments on specimens from the rocks, suggest strongly that at this particular quarry there are two different types of basic igneous rock. One, probably a basalt flow, may have suffered reheating by an olivine-nephelinite plug which comprises the main portion of the quarry.

Acknowledgement

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